

Catalysts

❑ Primary Candidates

- ❑ Sodium Hydroxide
- ❑ Potassium Hydroxide
- ❑ Sodium Methyleate

❑ Secondary Candidates

- ❑ GoBio T300



Sodium Hydroxide

☐ Pros

- ☐ Lower soap yields than potassium hydroxide
- ☐ Easily Accessed
- ☐ Easier to handle

☐ Cons

- ☐ Lower biodiesel yields
- ☐ Higher soap yields than sodium methyllate



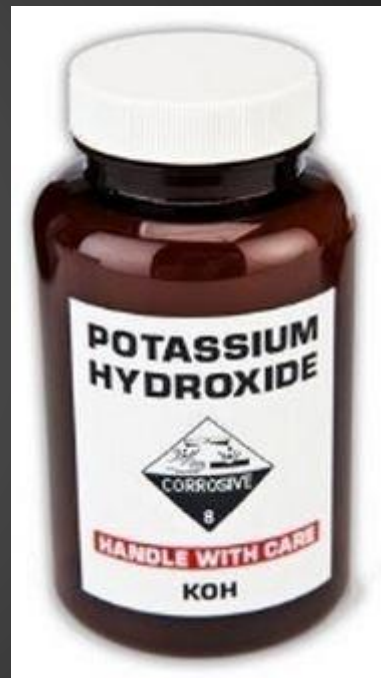
Potassium Hydroxide

☐ Pros

- ☐ Higher biodiesel yields than sodium hydroxide
- ☐ Easily Accessed

☐ Cons

- ☐ Higher soap yields than sodium methylete and sodium hydroxide
- ☐ Must have air tight storage



Sodium Methylate

☐ Pros

- ☐ Liquid form
- ☐ Easily integrated into the process
- ☐ Doesn't introduce extra water into the system
- ☐ High yield

☐ Cons

- ☐ Harder to access
- ☐ Long term storage



GoBio T300

- ❑ A direct catalytic replacement for sodium methylate
- ❑ Granular solid
- ❑ Crude glycerin has >95% purity
- ❑ Significantly reduces hazardous material generation



GoBio T300

- ❑ 3% T-300, 160F, 0.25 MeOH, 2x1.5 hr
- ❑ Dry washed samples meet all ASTM specs
- ❑ Distillation produces USP glycerin and high purity FAME



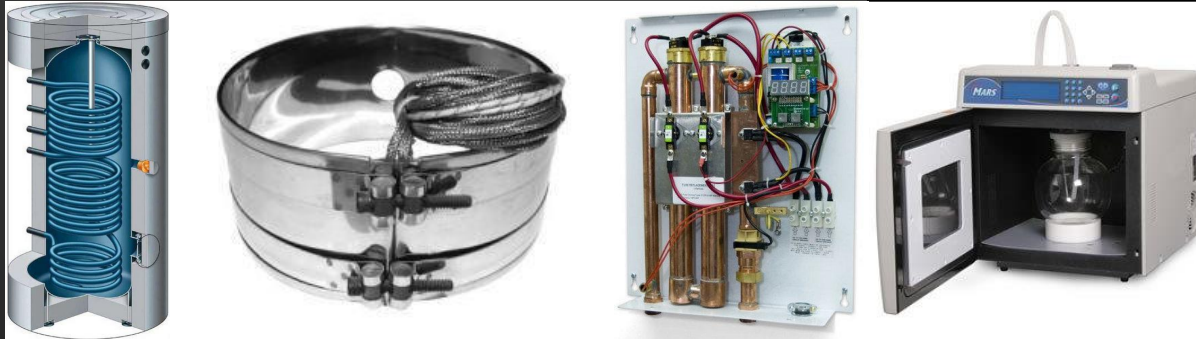
Biodiesel Heating Methods

☐ Internal Coils

☐ Inline Heater

☐ External Coils

☐ Microwave



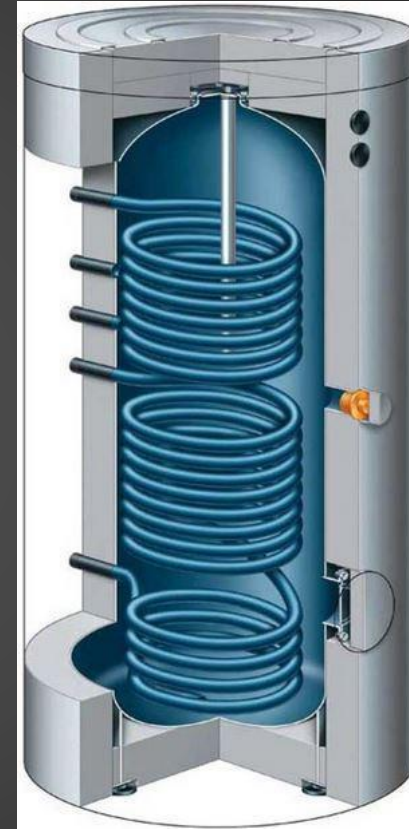
Internal Coil

❑ Pros

- ❑ Direct Heat Transfer
- ❑ Mechanical Simplicity
- ❑ Easy component cleaning
- ❑ Low Cost

❑ Cons

- ❑ Slower
- ❑ Requires unique design layout
- ❑ Somewhat inefficient
- ❑ Wetted Surfaces



External Coil

❑ Pros

- ❑ Low Cost
- ❑ No cleaning necessary
- ❑ Existing installation
- ❑ Mechanical simplicity

❑ Cons

- ❑ Very Slow
- ❑ Indirect heat transfer
- ❑ High inefficiency



Inline Heater

❑ Pros

- ❑ Direct heat transfer
- ❑ Easily scaleable
- ❑ Moderate Cost
- ❑ Can be designed in-house

❑ Cons

- ❑ Moderate efficiency
- ❑ Wetted surfaces
- ❑ Mechanical complexity



Microwave

☐ Pros

- ☐ Very Fast (down to <1 min)
- ☐ Direct reaction agent
- ☐ High conversion effectiveness
- ☐ High efficiency
- ☐ No wetted surfaces (if heated in pipes)
- ☐ Ethanol may be useable

☐ Cons

- ☐ Test-scale only
- ☐ Lower processing volumes (in test scales)
- ☐ Experimental Phase



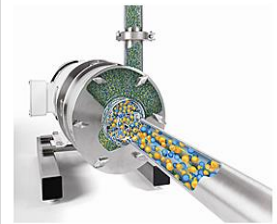
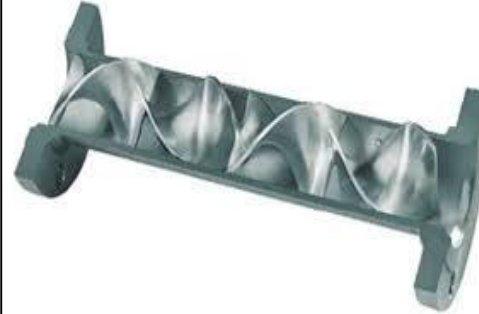
Biodiesel Mixing Methods

❑ Primary Candidates

- ❑ Agitation
- ❑ Sonification
- ❑ Inline Static

❑ Secondary Candidates

- ❑ Inline high shear
- ❑ Batch high shear



Agitation

☐ Pros

- ☐ Cheap
- ☐ Simple
- ☐ Existing installation
- ☐ Easy cleaning access

☐ Cons

- ☐ Slow and minimal effect
- ☐ Does not circulate
- ☐ Macro-effect only



Sonification

☐ Pros

- ☐ High effectiveness
- ☐ Continuous performance
- ☐ Fast
- ☐ Wetted parts durable
- ☐ Aids reaction on micro level

☐ Cons

- ☐ Expensive
- ☐ Requires unique design layout



Inline Static

☐ Pros

- ☐ Simple Installation
- ☐ Low cost
- ☐ Small footprint
- ☐ CIP w/ rest of system
- ☐ Can be selected with dynamic shearing
- ☐ Can be installed with dosing inlet

☐ Cons

- ☐ Loss of pressure
- ☐ Macro effect (normal)



High-shear

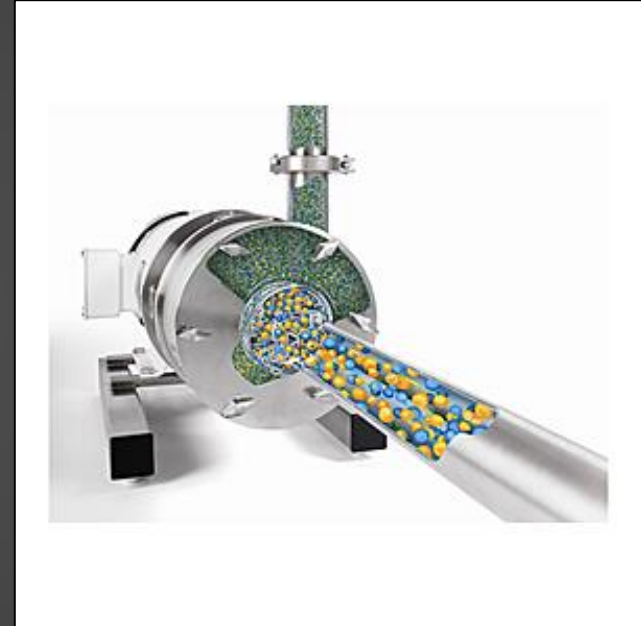
Batch and Inline

☐ Pros

- ☐ High micro effect
- ☐ Strong circulatory or agitation
- ☐ Speeds reaction process
- ☐ Polished surfaces

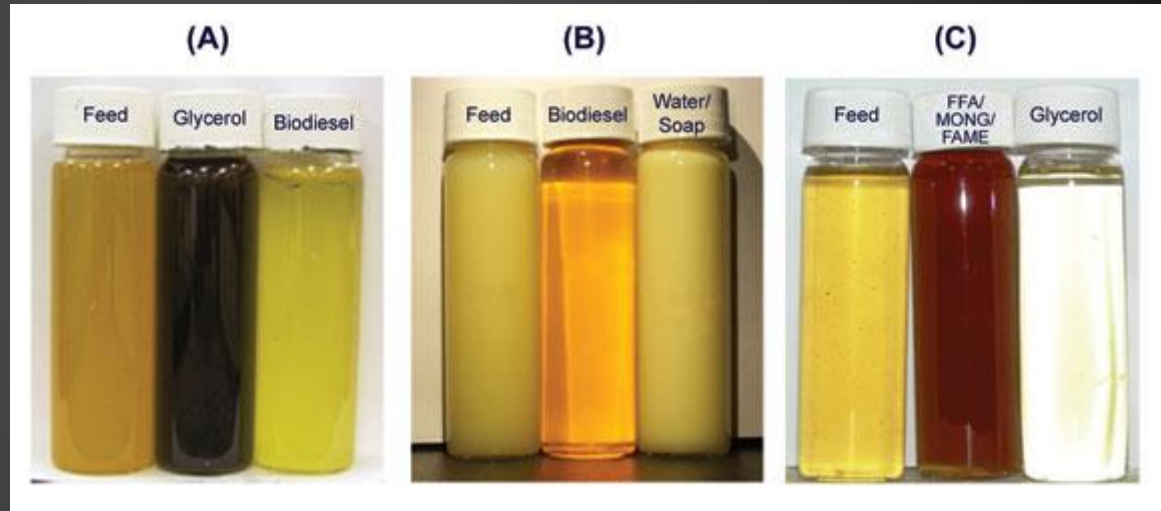
☐ Cons

- ☐ Expensive
- ☐ Require additional maintenance



Purification and Separation

- ❑ Ion Exchange
- ❑ Water Wash
- ❑ Coalescers
- ❑ Centrifuge
- ❑ Organic Washing
- ❑ Magnesol



Ion Exchange

☐ Pros

- ☐ Reusable
- ☐ Flexible
- ☐ Small footprint
- ☐ Reasonable Price

☐ Cons

- ☐ Methanol vapor in open column
- ☐ Requires regular maintenance
- ☐ Requires equipment installation
- ☐ Recommended pre-ion soap removal

Water Wash

☐ Pros

- ☐ Cheap
- ☐ Flexible
- ☐ Recoverable
- ☐ Effective

☐ Cons

- ☐ Requires water treatment
- ☐ Requires settling drying time
- ☐ Risk of emulsion (acidic solutions)
- ☐ Generally requires multiple passes

Coalescer

☐ Pros

- ☐ Low energy usage
- ☐ Low lifetime cost
- ☐ Low maintenance
- ☐ Short residence time

☐ Cons

- ☐ Requires gravity feed
- ☐ Fairly low flow rates
- ☐ Large footprint
- ☐ Requires methanol pre-removal

Centrifuge

☐ Pros

- ☐ Fast
- ☐ Effective
- ☐ Existing equipment
- ☐ Easy CIP

☐ Cons

- ☐ Expensive if purchasing new
- ☐ High energy use
- ☐ Large footprint
- ☐ Can require multiple passes

Organic Filtering

☐ Pros

- ☐ Cheap
- ☐ Recycled/Green

☐ Cons

- ☐ Adds contaminants
- ☐ Retains methanol
- ☐ Adds additional waste stream
- ☐ Gravity fed
- ☐ Large footprint

Magnesol

☐ Pros

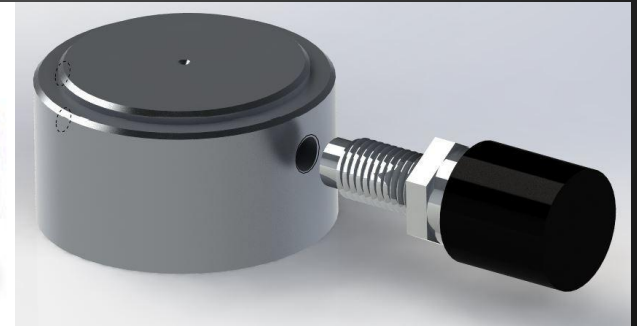
- ☐ No water-effluent stream
- ☐ No emulsification
- ☐ Minimal yield loss
- ☐ Minimal capital investment
- ☐ Absorbs residual water

☐ Cons

- ☐ Not reusable
- ☐ Requires post-use filtration
- ☐ Waste stream

Ingredients Metering

- ❑ Flow Meter
- ❑ FlowStat Sensor
- ❑ Ultrasonic Transmitter
- ❑ Digital Scale



Flow Meter

- ❑ Inexpensive
- ❑ Highly accurate
- ❑ Repeatable turbine flow sensor
- ❑ Designed for low flow



FlowStat Sensors

- ❑ Inexpensive
- ❑ Highly accurate
- ❑ 0.5-15 GPM
- ❑ Measuring accuracy: $\pm 2\%$ of full-scale
- ❑ Visible flow



Ultrasonic Transmitter

- ❑ Range: 2 in to 4.1 ft
- ❑ Accuracy: 0.125 in
- ❑ Resolution: 0.019 in
- ❑ Cost: \$280



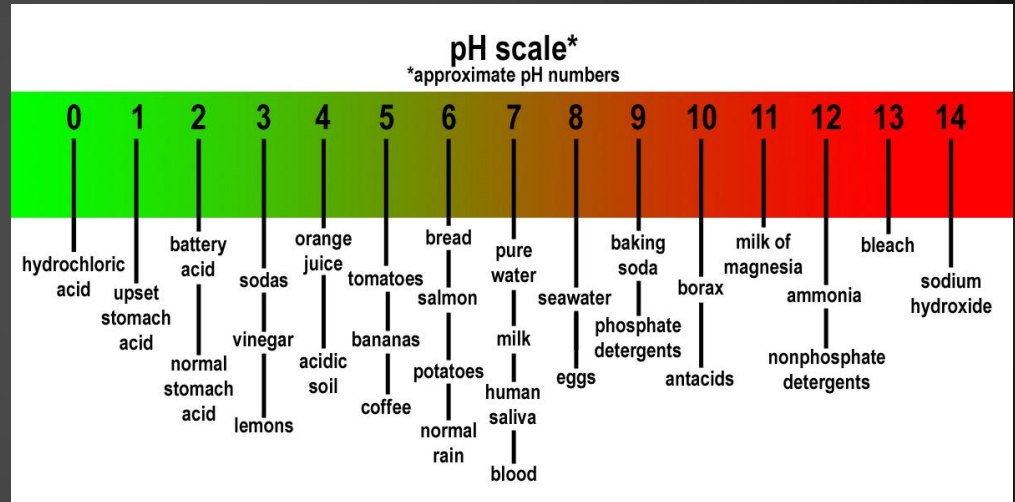
Digital Scale

- ❑ Designed in house
- ❑ Inexpensive
- ❑ Measures mass
- ❑ Programmable



Process Controls

- Thermocouple
- Viscosity
- Opacity
- pH
- Conductivity



Thermocouple

☐ Pros

☐ Cons

Viscosity

☐ Pros

☐ Cons

pH

☐ Pros

☐ Cons

Conductivity

☐ Pros

☐ Cons